Daniel Coats
February 2022

Report on Occurrence of Damaging Winds at Riverside Municipal Airport

In the past 18 months, gale-force winds during offshore flow events have resulted in spectacular tree and building damage in the Ramona and Arlington areas of the City of Riverside. Instances include the uprooting of a large pine tree in Hunt Park, the collapse of a eucalyptus tree on the campus of Chemawa Middle School, and severe damage to a women's dormitory at California Baptist University due to the fall of a large pine tree.

Advisory-force winds (sustained at 31 mph or gusts above 46 mph) occurred at Riverside Municipal Airport, the closest official National Weather Service station, on six occasions in 2021, anecdotally much more frequently than in a typical year.

In a time in which climate change is a major societal concern, what of the frequency of damaging winds in this community?

To assess the situation, I have examined records for Riverside Municipal Airport since summer 1998, when the weather station there began operation. I am hesitant to introduce records from another site (such as the Riverside Fire Station, where data has been collected since 1893), considering the very localized nature of wind events in Southern California.

While gaps in record keeping are problematic, data suggests that extreme wind events have occurred much more frequently since January 2020 than was the case in the 2010s. However, high wind events also occurred with greater frequency during the 2000s.

The maximum wind speed observed over a quarter century is in the low to mid 50s in gusts and mid 40s in sustained speeds. These conditions have occurred on a number of occasions but have never been exceeded. There are anecdotal reports of wind speeds in the 60s (such as in news reports from California Baptist University during the Feb. 2 pine tree collapse). But there is not officially verifiable data to corroborate these reports[i].

When and How Damaging Wind Events Occur

A cursory look at high wind events at Riverside Airport show that such instances occur during one of two conditions: offshore flow (typically called Santa Ana winds, which may be of either hot or cold temperature depending on jet stream placement) or during thunderstorms or rain events.

The former have become more common over time as California remains in drought conditions, while the latter has become less frequent (though not unheard of), as heavy rain events become somewhat less frequent with the rise in drought conditions.

Most afternoons in the spring and summer feature a bout of west winds associated with onshore flow. However, maximum gusts almost always remain below 30 mph and these conditions do not appear to be associated with truly damaging winds.

Because offshore flow events and heavy rainfall both tend to occur during the cooler six months of the year, the occurrence of high winds at Riverside Airport are strongly skewed toward the October to April period. November, December, January and February have the highest risk. Though there have been notable exceptions. On July 22, 2006, for instance, a wind gust of 55 mph was recorded during a freak summer thunderstorm.

High Wind Events Through the Years

As the data below demonstrates, high wind events are not distributed evenly through the past 25 years. They were much more frequent in the late 1990s and early 2000s, again in the mid/late 2000s, and in the past three years. In between were extended periods with few, if any, high wind events.

All three eras of greater frequency coincided with spikes in what is now understood to be the longstanding drought that began after the 1997-1998 rain season.

Particularly the 2000, 2002 and 2007 data is likely underreported (perhaps by as much as 25%) due to reporting gaps. When considering this, it is certainly possible that the frequency during those years matched 2021. Recollection of conditions at the time are comparable as well.

It should also be noted that years with no high wind events were not necessarily calm years. Many times, there are multiple instances in which speeds were just a mile per hour or two below the threshold.

YEAR	NUMBER OF HIGH WIND EVENTS (DEFINED AS SUSTAINED AT 31 MPH OR GUSTS OF 46 MPH OR ABOVE)
1998 (after July 1)	**1**
1999	**3**
2000	**1**
2001	**1**
2002	**4**

2003	**1**
2004	**0**
2005	**0**
2006	**3**
2007	**4**
2008	**0**
2009	**0**
2010	**0**
2011	**0**
2012	**1**
2013	**0**
2014	**1**
2015	**0**
2016	**2**
2017	**0**
2018	**0**
2019	**1**
2020	**3**
2021	**6**
2022 (as of Feb. 7)	**1**

Conclusions

Riverside Airport has extreme wind events due to two conditions: offshore flow and traditional rain/thunder storms. The geographic distribution of the former is unlikely to shift significantly since it is rooted more in geology than in meteorology. The winds funnel down the passes (most relevantly for the location Cajon Pass) when ridges of high pressure or “inside slider” low pressure systems build over the Great Basin. However, the frequency of such events are higher during drought years, since the winter ridging associated with those winds occurs much more frequently. Should drought conditions become more frequent, greater frequency (not necessarily intensity and certainly not different geographical distribution) can be anticipated.

The latter is more variable and could become more common with time in a warmer atmosphere, as many scientists allege globally. However, if the Southern California region remains locked in drought conditions more frequently than not, such events may continue to become less common due to rarer occurrence of severe weather (unless those few instances of heavy rain and thunder result in strong winds).

It is also quite possible that high wind events of any nature may become more damaging in the future as large trees, often already unsuited for the Inland Empire climate, become increasingly water stressed due to chronic drought and potential periodic water restrictions.

[i] Much higher wind speeds are officially recorded at Ontario International Airport and sites in Jurupa Valley, but these should not be taken as indicative of the situation in western Riverside city, considering the closer proximity to the former locations to the Cajon Pass, where some of the strongest wind gusts are recorded during offshore flow events.